

# Nicotinic Acid. Miscellaneous Esters<sup>1</sup>

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Several esters of nicotinic acid have been reported recently.<sup>2,3</sup> Some new miscellaneous esters have been prepared in this Laboratory, and, since the work has been terminated, we are reporting these compounds and the two additional methods used in their preparation.

The first method used was the direct reaction of the alcohol with nicotinyl chloride hydrochloride. The second method involves the reaction of nicotinic anhydride<sup>4</sup> with the alcohol. The following examples will serve to illustrate the methods.

## Method A. Glycol Dinicotinate

Into a round-bottomed, three-necked flask equipped with air-tight stirrer, dropping funnel, and condenser equipped with a calcium chloride drying tube was placed 61.5 g. (0.5 mole) of nicotinic acid. Stirring was started, and 178 g. (1.5 moles) of redistilled thionyl chloride was added dropwise at a fairly rapid rate. After addition was complete, the reaction mixture was refluxed for two hours.

plate with continuous stirring for fifteen minutes. The reaction mixture was then dissolved cautiously in water and made strongly alkaline with concentrated ammonium hydroxide, and the crystalline glycol dinicotinate was filtered off. The product was washed with three 100-cc. portions of dilute ammonium hydroxide and dried. The yield was 36 g. or 91.2% of theoretical. The glycol dinicotinate thus prepared had a m. p. of 127.0–128.0°. Recrystallization from 400 cc. of 40% alcohol following Norit treatment gave 32 g. of product of the same melting point. Three recrystallizations did not raise the melting point.

## Method B. Trinicotinin

Into a 200-cc. round-bottomed, three-necked flask equipped with a stirrer and reflux condenser equipped with a drying tube, was placed 20.5 g. (0.09 mole) of nicotinic anhydride, 12 cc. of anhydrous pyridine and 1.84 g. (0.02 mole) of redistilled, anhydrous glycerol. The mixture was heated on the steam-bath for four hours with continuous stirring. The reaction mixture was poured into 100 cc. of water and made strongly alkaline with sodium carbonate solution, and the oil layer was extracted with three 40-cc. portions of chloroform. The chloroform extract was washed with three 25-cc. portions of water and dried over anhydrous sodium sulfate. The chloroform and pyridine

TABLE I  
PROPERTIES OF NICOTINIC ACID ESTERS

Compound <sup>a</sup>	Formula	M. p., °C.	Carbon		Hydrogen		Nitrogen		Milliequiv. alkali per g. of ester	
			Calcd.	Found	Calcd.	Found	Calcd.	Found	Calcd.	Found
Nicotinate										
Phenyl	C <sub>12</sub> H <sub>9</sub> NO <sub>2</sub>	74.2–75.0	72.35	72.69	4.55	4.70	7.03	6.87	5.02	5.01
Cyclohexyl	C <sub>12</sub> H <sub>15</sub> NO <sub>2</sub>	<sup>b</sup>	70.22	70.29	7.37	7.34	6.82	6.79	4.87	4.84
Isopropylidene glycerol <sup>c</sup>	C <sub>12</sub> H <sub>17</sub> NO <sub>2</sub>	41.4–41.9 <sup>d</sup>	60.75	60.27	6.37	6.33	5.91	5.85	4.21	4.18
Glycol di- <sup>e</sup>	C <sub>14</sub> H <sub>13</sub> N <sub>2</sub> O <sub>4</sub>	126.7–127.1	61.76	62.30	4.44	4.94	10.29	10.29	7.34	7.35
α-Naphthyl	C <sub>16</sub> H <sub>11</sub> NO <sub>2</sub>	70.0–70.6	77.09	77.45	4.41	4.68	5.63	5.62	4.01	4.02
Pentaerythritol tetra-	C <sub>20</sub> H <sub>31</sub> N <sub>4</sub> O <sub>8</sub>	162–163	62.58	62.30	4.35	4.49	10.07	9.61	7.20	7.20
Inositol hexa-	C <sub>18</sub> H <sub>25</sub> N <sub>4</sub> O <sub>12</sub>	254.3–254.9	62.22	62.16	3.73	4.12	10.37	9.97	7.40	7.36
Trinicotinin <sup>f</sup>	C <sub>21</sub> H <sub>17</sub> N <sub>3</sub> O <sub>6</sub>	87.6–87.8	61.91	61.42	4.21	4.34	10.31	10.28	7.36	7.39
α-Monomyristin dinicotinin <sup>e</sup>	C <sub>20</sub> H <sub>16</sub> N <sub>2</sub> O <sub>6</sub>	58.6–59.2	67.94	68.07	7.87	8.04	5.47	5.42	5.85	5.85

<sup>a</sup> These substances were all made by Method A unless otherwise indicated. <sup>b</sup> B. p. 144.5° at 4.1 mm.; <sup>n</sup><sub>D</sub> 1.5177; <sup>d</sup><sub>20</sub> 1.0941. <sup>c</sup> Used Method B. <sup>d</sup> B. p. 143–144° at 1.2 mm. <sup>e</sup> Yield, Method A, 91.2%; yield, Method B, 93.6%. <sup>f</sup> Used Methods A and B.

The condenser was then set for distillation, and the excess thionyl chloride was distilled off while the reaction mixture was stirred to prevent formation of a hard cake. Approximately 300 cc. of anhydrous benzene was added. The nicotinyl chloride hydrochloride was filtered off, washed twice with 100-cc. portions of anhydrous benzene and sucked almost dry on a Buchner funnel.

The nicotinyl chloride hydrochloride was immediately transferred to a 600-cc. beaker, and 9 g. (0.145 mole) of ethylene glycol was added with stirring. The reaction was exothermic. After evolution of hydrogen chloride had ceased, the mixture was heated to about 100° on a hot-

were removed by evaporation, leaving an oil which crystallized when scratched with a stirring rod and cooled in an ice-bath. The yield of trinicotinin was the theoretical. The melting point was 87.7–88.8°. The melting point was not raised by repeated recrystallization from acetone-petroleum ether.

Isopropylidene glycerol<sup>5,6</sup> and α-monomyristin<sup>7</sup> were prepared in accordance with the literature methods and used in the preparation of the mixed glycerides. Table I gives the analytical data and physical constants of the new esters.

- (5) Irvine, McDonald and Soutar, *J. Chem. Soc.*, **107**, 337 (1915).
- (6) Newman and Renoll, *THIS JOURNAL*, **67**, 1621 (1945).
- (7) Averill, Roche and King, *ibid.*, **51**, 866 (1929).

- (1) Article not copyrighted.
- (2) Badgett, Provost, Ogg and Woodward, *THIS JOURNAL*, **67**, 1135 (1945).
- (3) Huber, Boehme and Laskowski, *ibid.*, **68**, 187 (1946).
- (4) Badgett, *ibid.*, **69**, 2231 (1947).